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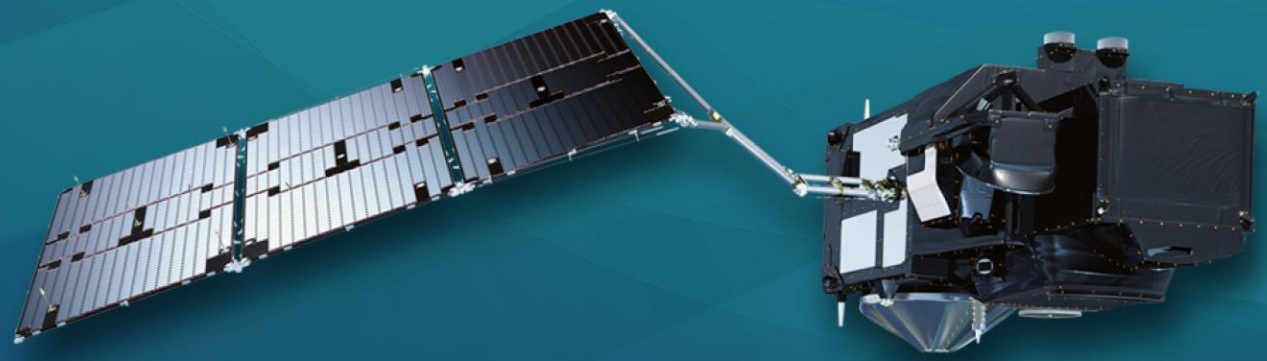


9th Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

Ten Years of Sentinel-3 Microwave Radiometers: Operational Instruments Monitoring and Quality Assessment within the S3MPC-STM project

H. Roinard [1], A. Saint Georges-Chaumet [1], L. Amarouche [1], J. Aublanc [1], A. Chamayou [1], M. Restano [2], F. Catapano [2], A. Di Bella [2]

[1] Collecte Localisation Satellite, Ramonville Saint-Agne, France, [2] European Space Agency, Frascati, Italy

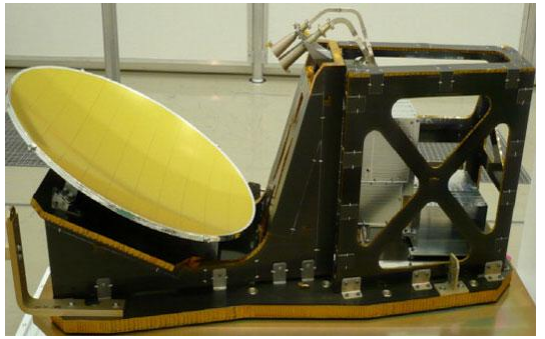
Context

https://sentiwiki.copernicus.eu/web/s3-altimetry-instruments

Under the Sentinel-3 Mission Performance Cluster (S3MPC-STM), the MWR sensors on both Sentinel-3A and -3B are continuously monitored, with instrumental and Level-2 land product validation performed on a cyclic basis

Cyclic and annual reports available here :
https://sentiwiki.copernicus.eu/web/document-library#Library-S3-Performance-DQR-SRAL

The MWR is critical for estimating atmospheric water vapor content, providing the Wet Tropospheric Correction (WTC) required to compensate for signal path delay in altimetry



MWR Instrument [Credits: ESA]

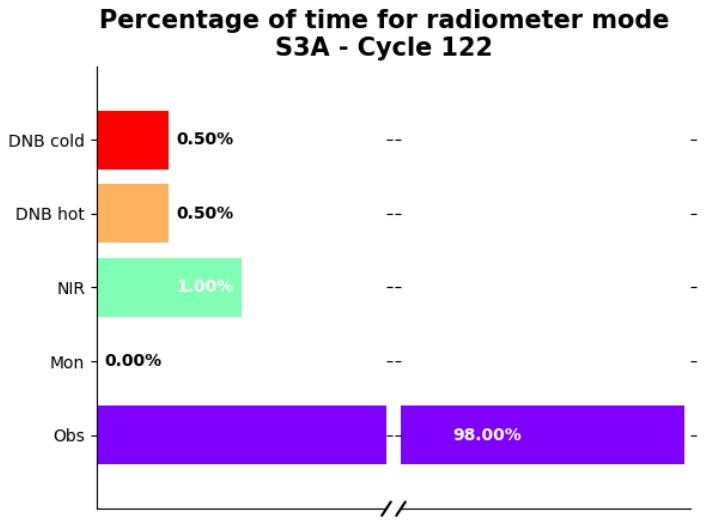
This presentation summarizes the current operational status of both Sentinel-3 MWR instruments, **confirming their robust health and long-term performance stability over the past decade**

Data used are homogeneous Baseline Collection 005 dataset

Operating mode & processing mode

The radiometers on-board S3A and S3B have several **operating modes** :

- Mode 0 : Intermonitoring (Earth **observation**)
- Mode 1 : Monitoring
- Mode 2 : Noise Injection **calibration**
- Mode 3 : Dicke Non-Balanced **calibration** (100% injection – hot point)
- Mode 4 : Dicke Non-Balanced **calibration** (50% injection – cold point)

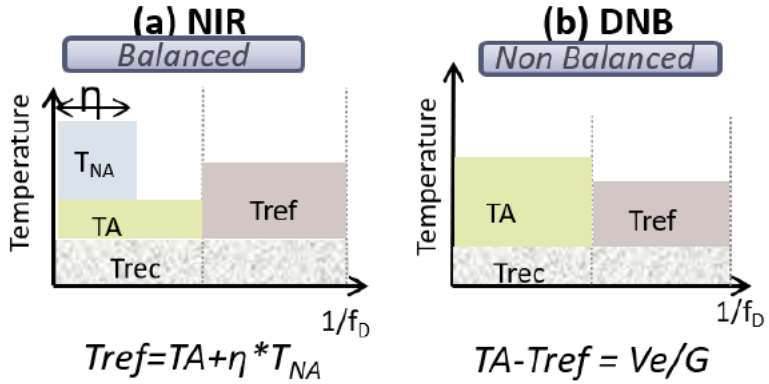


➔ **Observation mode for 98% measurements (2% for calibrations)**

- Identical since the update of calibration timeline of the 1st March 2018.
- Calibration sequences are ~0.6s and occurs every 30 seconds.

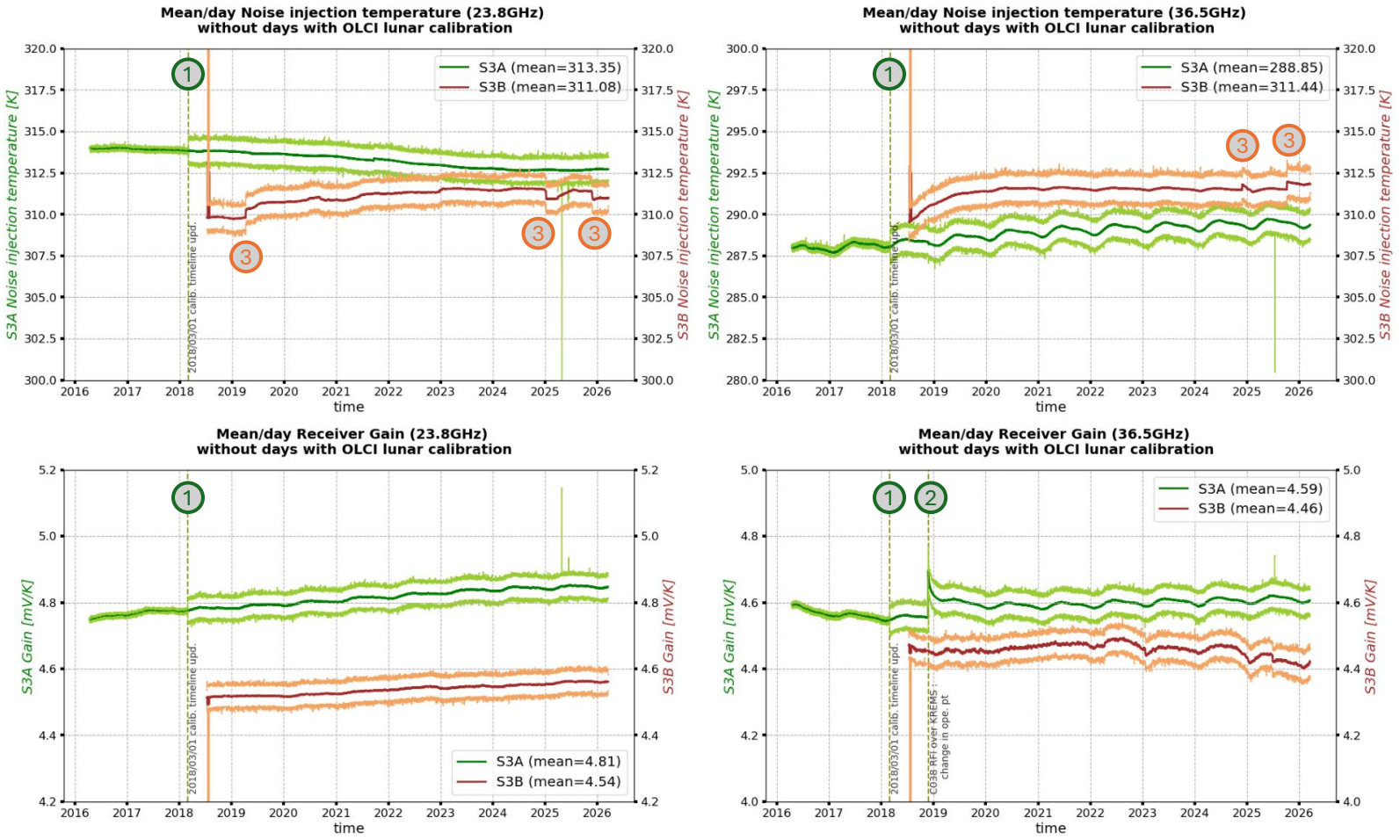
Processing modes (during observation mode):

- Noise injection radiometers (main mode), based on a Dicke architecture with the addition of noise to achieve the balance between the two signals (the input temperature and the reference temperature).
- DNB (Dicke Non Balanced) mode: no noise injected to the antenna path.



Characterization and calibration monitoring

Noise Injection Temperature and gain



Some small jumps, drifts or seasonal signal in calibration parameters with no significant impact for both **Sentinel-3A** and **Sentinel-3B** MWR

Noise diode calibration

to be used in **the main processing mode**

→ Noise Injection Radiometer (NIR) mode

(3) Some small jumps on S3B both channels (unknown reasons)

Seasonal annual signal for S3A 36,5GHz channel

Gain calibration

to be used in the non-balanced mode

→ Dicke Non-Balanced (DNB) mode

Seasonal annual signal for S3A 36,5GHz channel

Main events :

(1) *S3A 2018/03/01 : calib update (increase of L2 availability) Applied on 2028/0525 for S3B*

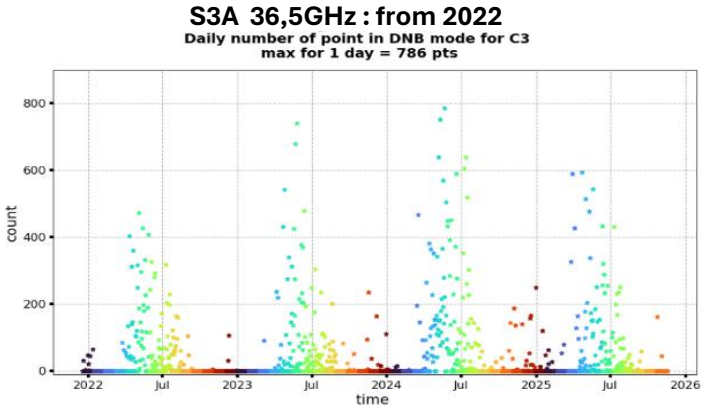
(2) *S3A 2018/11 : KREMS RFI → change in operating point*

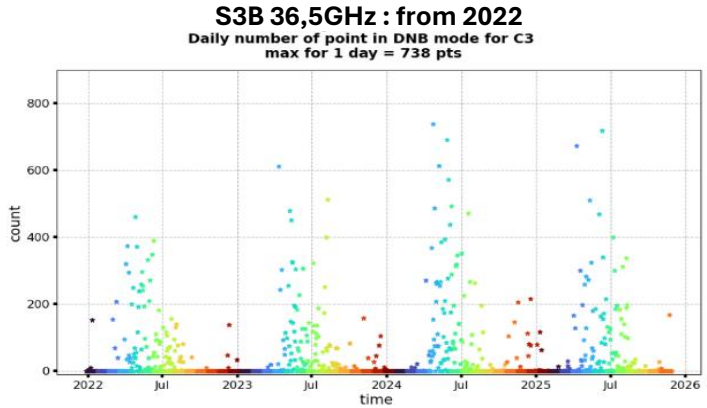
DNB mode

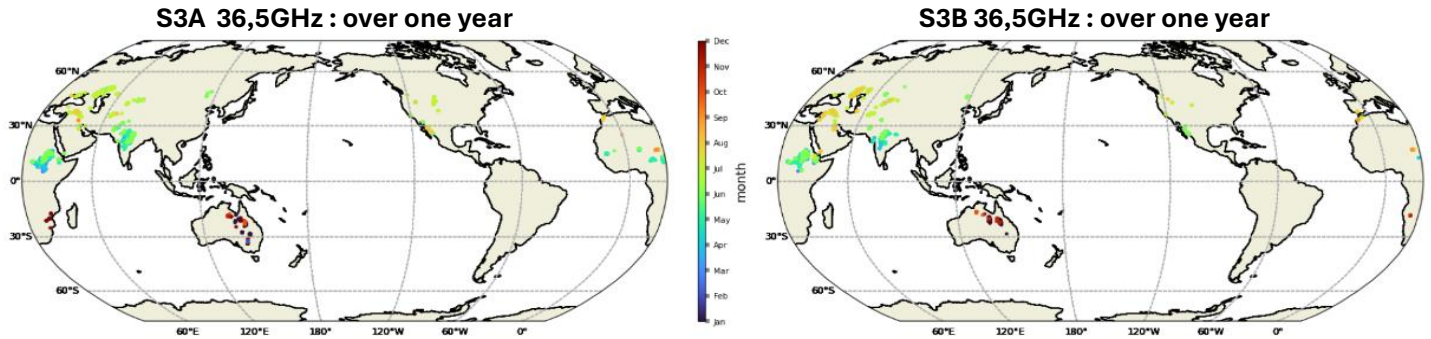
The DNB processing of the Earth measurements uses the calibration "GAIN" parameter.

→ only a small part of the measurements are processed in DNB mode.

→ Mainly for 36,5GHz channel







Transition from the Noise Injection Radiometer (NIR) to the Dicke Non-Balanced (DNB) processing occurs depending on the internal temperature of the MWR

T < Tref → NIR processing

T > Tref → DNB processing

The measured Brightness Temperatures (BT) depend on the emissivity of the surface, and of its temperature → a seasonal dependency in the geolocation and number of occurrences of the DNB measurements is observed.

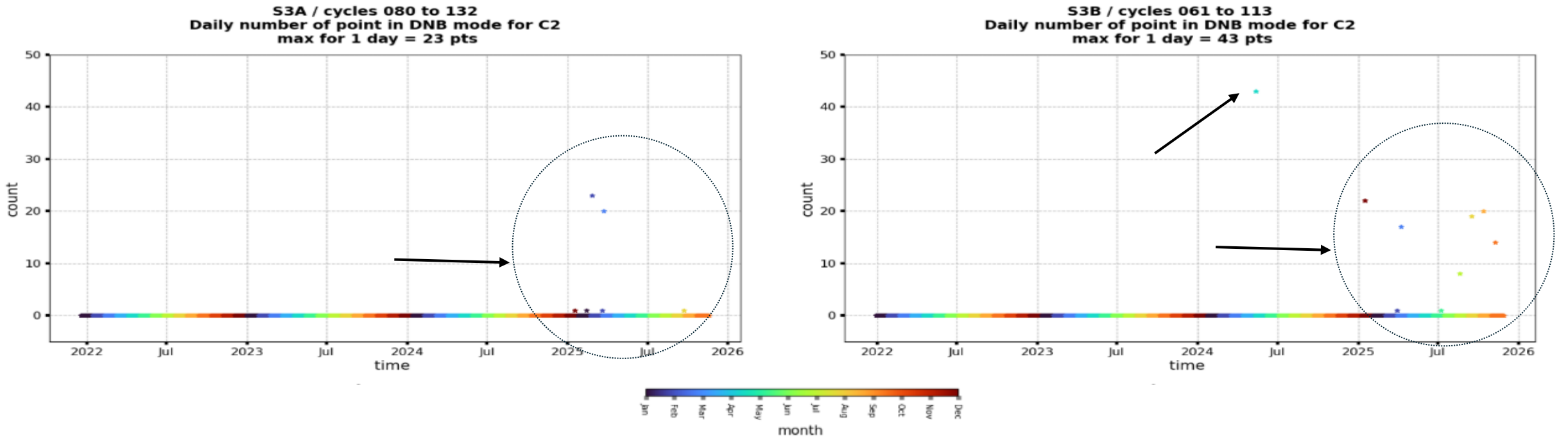
Same behaviour over years for liquid water channel, and similar on both missions

- ✓ Much more points using DNB processing from May to August than other months of the year.
- ✓ The closest to the equator in May and June
- ✓ Located higher in the North Hemisphere in June, July and August (summer for the North Hemisphere),
- ✓ Located lower in the South Hemisphere in Australia or South Africa in November and December (summer in the South Hemisphere).

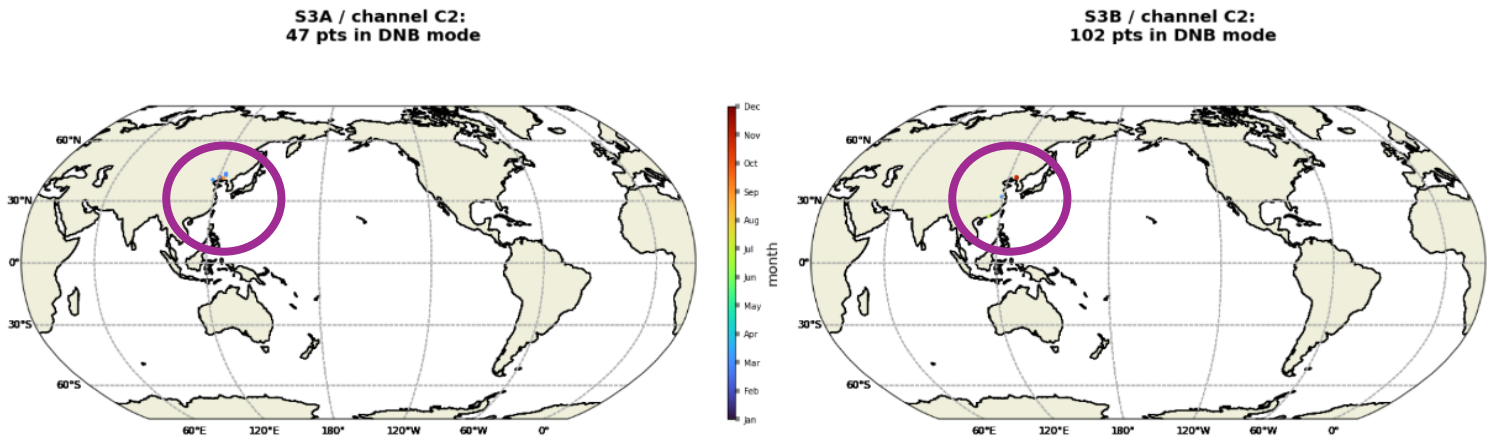
DNB mode : 23.8GHz channel

➔Change in instrumental behaviour over the last months :

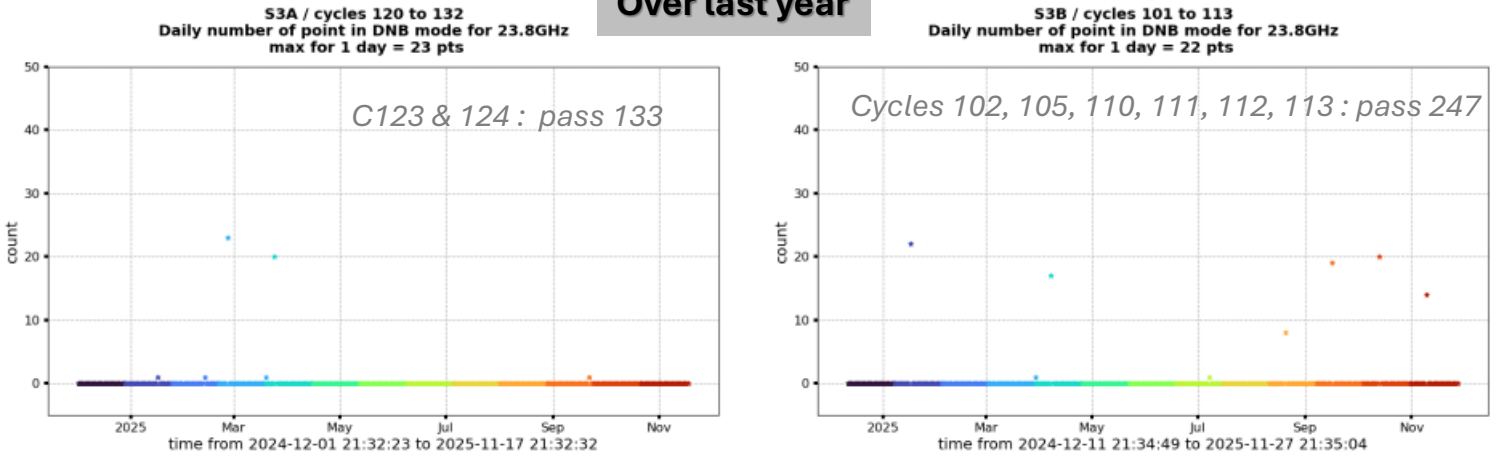
Some automatic switch in DNB mode occurrences for 23.8GHz channel occurred for both S3A and S3B this year



DNB mode : 23.8GHz channel



Over last year



➔ Automatic switch in DNB mode for 23,8GHz channel occurred for both S3A and S3B this year

- S3A : pass 133 of cycles 123 & 124
- S3B : pass 247 of cycles 102, 105, 110, 111, 112, 113

➔ Location over eastern China and Corea

➔ Near 13h UTC

➔ Very high level for antenna temperature

➔ Brightness temperature set to DV (over very short period)

➔ No impact on wtc estimation detected

➔ Visible on both S3A & S3B monitorings

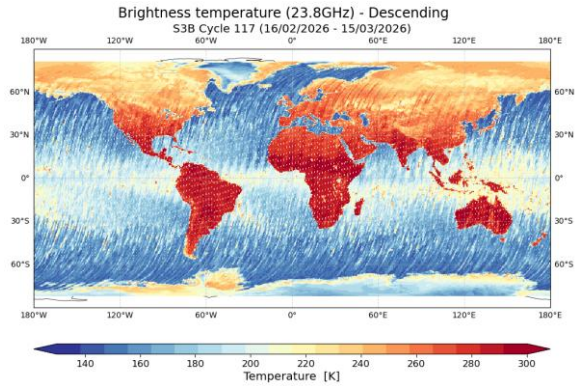
➔ Root cause under investigation

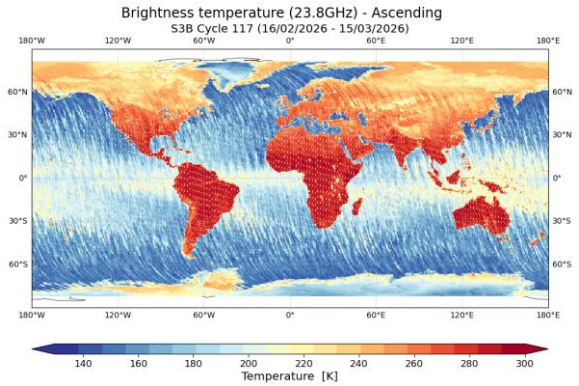
Geo-located brightness temperatures

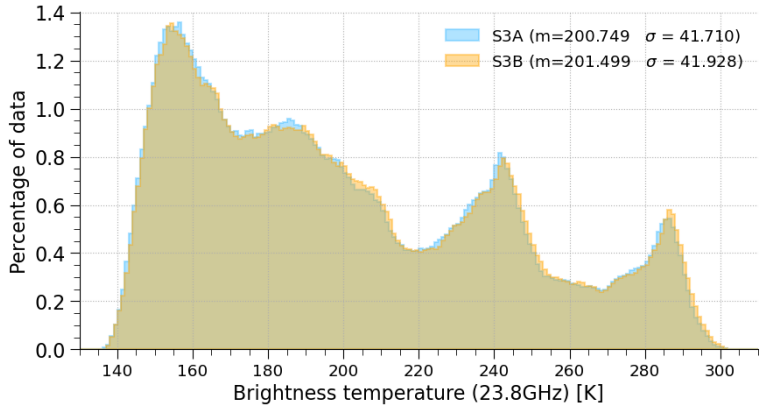
(L1B MWR, not distributed to users but used as input of level 2 thematic products)

Brightness temperatures estimations ➔ good global coherence between both missions thanks to intercalibration studies done during the commissioning phase (to be reproduced with S3C)

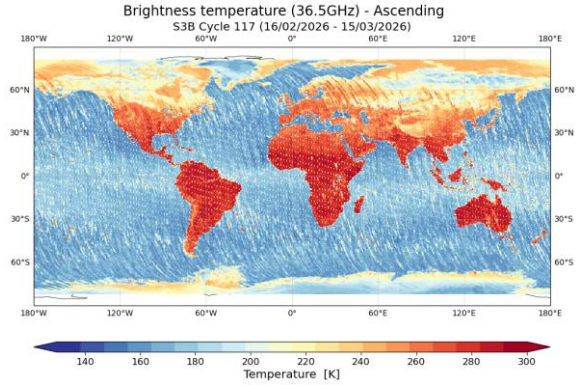
Water vapor channel

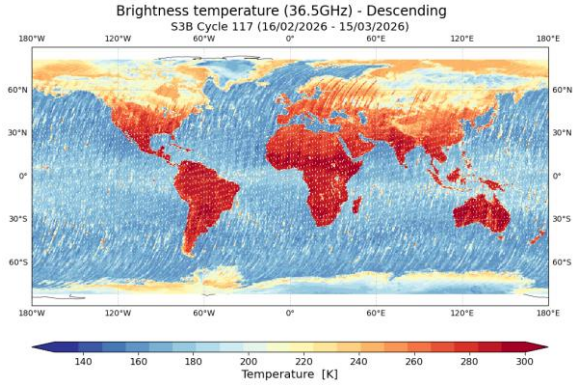


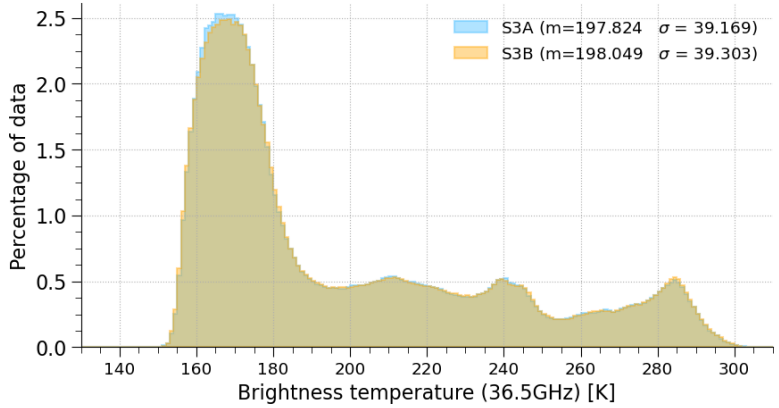




Liquid water channel







Long-term instrument stability : BT simulations

Measured brightness temperatures are also validated against simulated values derived from UCL Radiative Transfer Model and ECMWF profiles (temp & humidity).

Comparison of simulations of brightness temperatures :

for Sentinel-3A, Sentinel-3B, AltiKa, AMSU-A, Jason3

for two channels 23.8GHz (left) and 36.5GHz (right)

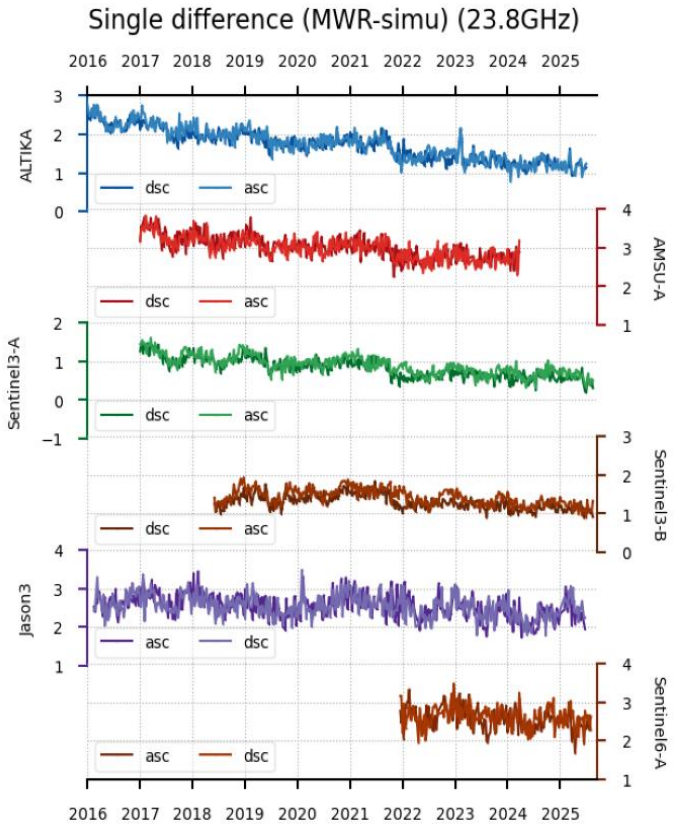
Analysis separating ascending/descending passes

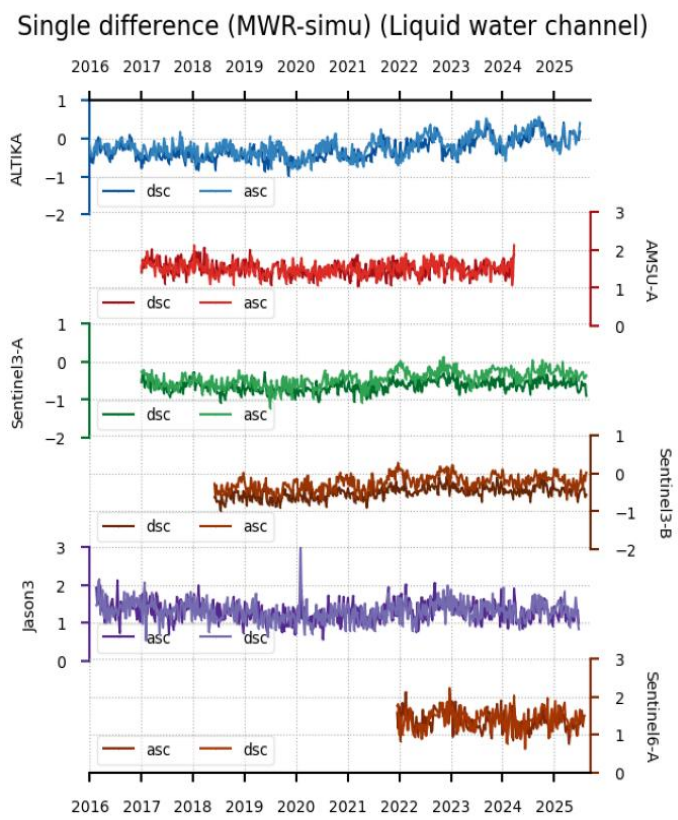
(some jumps linked to ECMWF version updates)

Reminder :

In the past, it allowed to detect significant discrepancies due to physical configuration onboard (thermal effects), that had been corrected thought BC005 reprocessing

(see Frery et al., 2020 publication
Remote Sens. **2020**, 12, 2590; doi:10.3390/rs12162590*)*

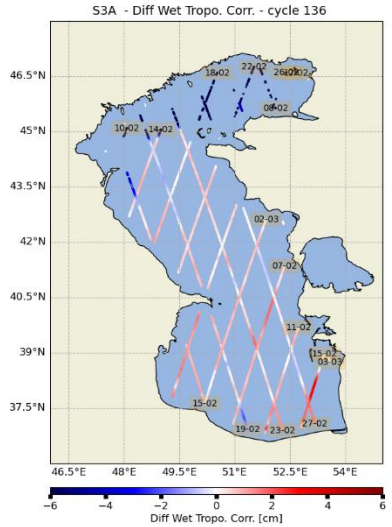


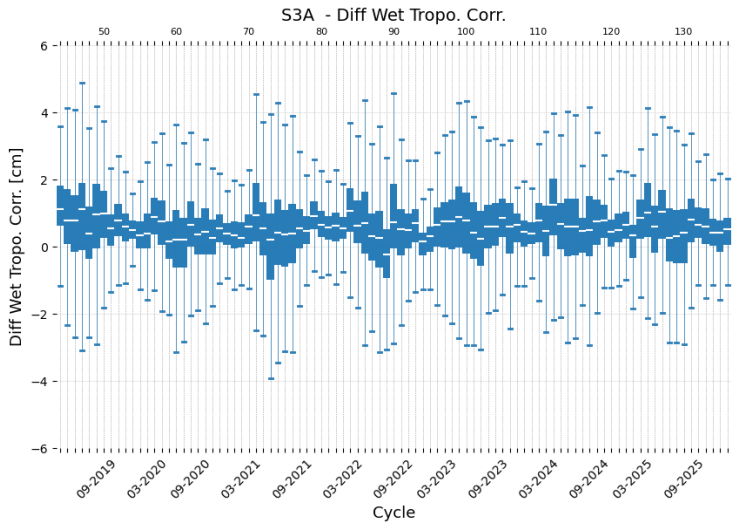


L2 variables assessment

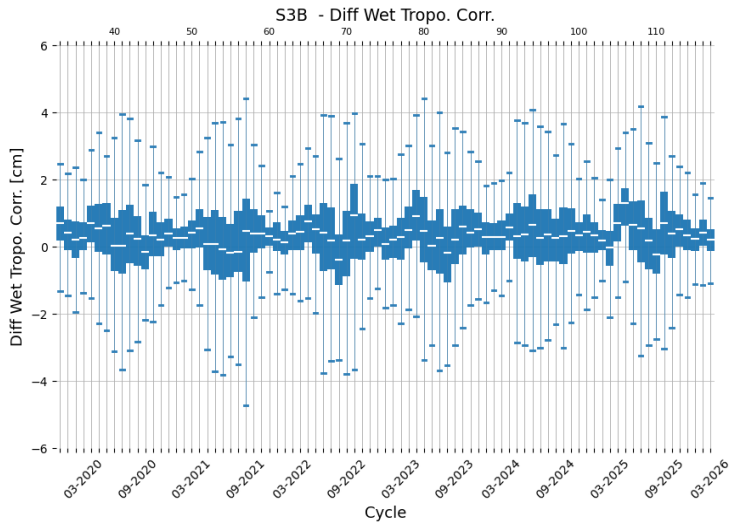
Assessment of geophysical product consistency, including wet tropospheric correction, atmospheric attenuation, water vapor and liquid water is conducted over the Caspian Sea.

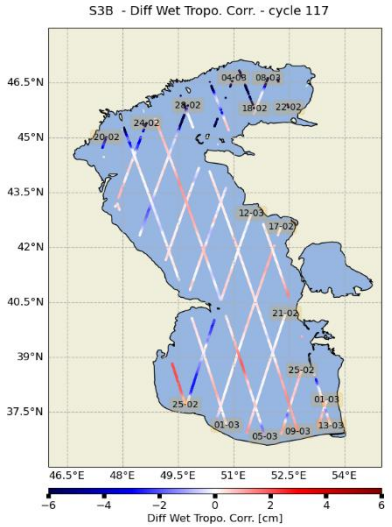
Sentinel-3A





Sentinel-3B





Wet tropospheric correction stability wrt model (Caspian sea)

➔ Good stability for both **Sentinel-3A** and **Sentinel-3B** MWR

Conclusions

Operational status of both Sentinel-3 MWR instruments :

robust health and long-term performance stability over the past decade

→ Additional analysis detailed in Alexis Saint Georges Chaumet's presentation about marine products

After commissioning phase, S3C' monitoring will be added to S3MPC-STM MWR Cyclic Performance Reports

THANKS FOR YOUR ATTENTION